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DEVELOPMENT OF MATERIAL SPECIFICATIONS AND QUALIFICATIONS OF POLYMERIC MATERIALS FOR THE JPL SPACECRAFT MATERIALS GUIDEBOOK

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I. Scope

This report covers the work performed during the period December 10, 1964 to February 10, 1965 on "Development of Material Specifications and Qualifications of Polymeric Materials for the JPL Spacecraft Materials Guidebook."

The over-all objective of this program is to provide assistance to the JPL staff members in the development of specifications and procedures for polymeric spacecraft materials. This includes definitions of properties, tests, and environments which are sensitive and meaningful, and collection of pertinent property, environmental, and materials data for use in specifications. Of particular importance to this program are the outgassing characteristics of various polymeric materials. The classes of materials to be examined were selected by the JPL cognizant engineers.

Current studies are concerned with the outgassing characteristics of adhesives of the epoxide type and of liquid and paste silicones.

II. Work Accomplished

Investigation of the effect of thermal-vacuum environment (150° and 200° C/1x10^{-6} mm Hg) on the outgassing characteristics of Shell's epoxide adhesives has been essentially completed, and preliminary specification data have been sent to the JPL cognizant engineer.

Shell adhesives 901B-3, 903, 914, 917, 931, and 934 appear to be suitable for use where temperature conditions do not exceed 150° C. However, Epon adhesives 931 and 934, which are based on an epoxide other than that of the diglycidyl ether of bisphenol A type, do give off large amounts of a condensable oil when temperatures exceed 150° C. Epon 422J has satisfactory outgassing characteristics only if it has been post-cured (either in nitrogen or in air) for at least six hours at 176° C (350° F). Without this post-curing, there is a relatively large evolution of volatiles, including a significant quantity of ammonia. The data on Epon adhesives 941 and 924 indicate that they are unsuitable for spacecraft use.

Preliminary studies on the liquid and paste silicone potting materials have begun. If the materials are not post-cured, the weight losses at $150^{\circ}C/2x10^{-6}$ mm Hg for 200 hours are as follows:

RTV 60	1.6%
RTV 21	1.8%
RTV 615	1.95%
RTV 11	2.65%
RTV 560	3.35%
RTV 511	4.35%

A study of the post-curing effect on these materials has begun. The recommended post-cure for the RTV's, i.e., 24-hour heating at $150^{\circ}C$ in a forced draft oven, has been examined. Although this post-curing step has reduced the percent weight loss, evolution of a condensable oil is still evident.

III. Future Work

The condensable oil is being characterized to determine its origin, i.e., additive or uncrosslinked polymer. Once this has been done, appropriate processing steps to eliminate this undesirable off-gassing product will be explored.

Samples of additional silicone potting materials are being prepared for thermal-vacuum stability studies.